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NOVEMBER 6.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-one members present.

The deaths of John Gould Anthony and of Prof. James Orton, correspondents, were announced.

NOVEMBER 13.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two members present.

A paper entitled "On the Diameters of the Incisors of Rodents," by John A. Ryder, was presented for publication.

The Agricultural Ants of Texas.—Rev. H. C. McCook gave an abstract of a paper, in course of preparation, upon the Agricultural Ants of Texas, *Myrmica molefaciens*, Buckley (*M. barbata*, Smith). He had visited Texas during the summer, and, encamping in the midst of a large number of formicaries, had given several weeks to the study of these and the cutting ants. Mr. McCook referred to the first notice of the agricultural ants by Prof. Buckley, in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1860, and to the subsequent, much more detailed, observations of Dr. Gideon Lincecum. Notwithstanding the doubt with which Dr. L.'s statements had been received, Mr. McCook was able to verify many of his recorded facts, to complete many, to correct some, and to add new facts to the known history of these most interesting insects. The point chosen for study is in the neighborhood of Austin, Texas, upon the tableland to the southwest of the Colorado River and its affluent, Barton Creek. The soil is black and sticky, varying in depth from three feet to a few inches. The bed rock is limestone, which crops up in striated and punctured masses. The formicaries of the ants are very numerous, and are found along roads, in open prairies, in the very streets, sidewalks, gardens, and yards of Austin; one was even perceived in the stone-paved court of a hotel. They are, as found upon the hills, commonly flat, circular clearings, hard and measurably smooth, well enough described by Lincecum as "pavements." A few were found with low mounds in the centre, a few inches in height and two or three in diameter. These mounds were frequently composed of bits of gravel of one to two grains weight. The width of the formicaries varies from twelve feet to

two or three feet. They are invariably located in open sunlight. Yet the meridian heat of the sun is avoided, the ants ceasing work entirely at 12 M. and remaining housed until between 2 and 3 P. M. Very little work was done at night, except in cases where the nest had been disturbed. The process of making a clearing was observed, and suggested strongly the modes of pioneers in an American forest. "Stumps" of grass remained at the inner edge of the clearing; beyond these, ants were engaged cutting off the spires of grass. Generally the head was downward, mandibles applied quite close to the roots, and the stalk yielded under a combined process of cutting, pinching, tearing, and twisting. In one case a worker climbed to the top of the grass and gained the advantage of leverage by bearing down. The rank vegetation of the semi-tropical climate is kept in complete control; clearings were found among the tall thickets of wild sage and daisy which could not intrude upon the emmet preserves. From each formicary diverge roads in number from three to seven, widest at the home terminus, and extending for many feet—sixty feet, more or less—into the surrounding herbage. These roads are level and smooth, and in busy hours of the day are thronged by worker ants going and coming. The mode of gathering grain was completely observed, single insects having been followed from the nest to the harvesting grounds and back. Seeds were gathered from the ground, never from the plant. The seeds, which were collected in large quantities, were exhibited, and the report of the Botanical Section of the Academy upon the same, which had been made after careful examination by Messrs. Meehan, Burk, and Redfield, was read. The seeds were of small Euphorbiaceous and Rubiaceous plants, *Croton*, *Paspalum*, *Aristida stricta*, and *Buchloe dactyloides*, the common western buffalo grass. The last two named were the most numerous.

The chain of evidence that determines these ants to be true harvesters is as follows: 1st. Workers were seen gathering seeds and carrying them into the formicaries through the central gates. 2d. The same seeds were found in granaries within the opened formicaries. 3d. The same seeds with the outer shell removed were found in other granaries. 4th. The ants were found carrying out shells to the refuse heaps, which heaps, as reported by expert botanists from collections, contain no perfect seeds among them. Several observers, under Mr. McCook's direction, are noting the winter habits and the condition of the winter formicaries of these agriculturals, and, when these notes are complete, the entire paper will be given to the public. The reported sowing of a crop from year to year was considered, and so far confirmed that in many cases the clearings were found to be covered by crops of *Aristida*, which crops were as distinctly marked upon the clearings as a farmer's wheat or grass crop upon any particular field. The formicaries could be recognized at a distance by the circular mass

of tall yellow needle grass (*Aristida*). On the prairies and low land a sharp conical mound rises in the midst of a clearing more or less extensive. Specimens brought to Mr. McCook by Dr. Leidy, from Wyoming Territory, were identified as of the same genus, *M. occidentalis*, Cresson. Mr. Cresson had described the male as a separate species, *Myrmica seminigra*.

Several questions which arose were answered as follows: Why should the needle-grass (*Aristida stricta*) be planted upon the formicary clearings when seeds could be had all around the nest without that trouble? Evidently (if we are to suppose a planting) the saving of time and labor in harvesting thus accomplished might be a sufficient reason. Mr. McCook was unwilling as yet to commit himself to the theory of an intelligent planting of seeds by the ants. His opinion at present was that the ants simply preserve growths which accidentally arise from seeds carried out of the granaries for various reasons. It should be remembered that *only a portion* of the formicaries are thus covered, not one-half, perhaps one-third. Of twenty-two registered nests (in one list) in which the details are given in his field notes, ten are reported with needle-grass crops. This crop is usually on the margin of the clearing. Thus (extract from Notes, "No. 15. Space clear about one and a half feet diameter, needle-grass for two feet beyond on all sides. . . . 18. Small space at the gate open. A circular belt of six feet, total diameter, covered with needle-grass. 20. Small hill; about twelve inches clear space, eight inches (each side) of needle-grass. . . . 22. Four feet of clear space, gravel covering the space immediately surrounding the gate; tufts of needle-grass on outer edge. . . . 2. Two feet diameter bare; about one foot each side covered with needle-grass. . . . 4. Formicary four feet in diameter, with tufts of needle-grass." This will give a fair idea of the way in which the pavements run.

How did the naturalists of the last century account for the ancient sacred, classical, and popular opinion of the harvesting powers of ants, and how did they fall into the mistake of rejecting the ancient tradition? The mistake was doubtless due to the fact that no harvesting ants have yet been observed in northern Europe, whose naturalists gave tone to the natural history of the last century. The more widely extended research of very recent times has brought opinion back to the old channel. The origin of the opinion was accounted for by those who rejected it by supposing that the yellowish grain-like cocoons (the "eggs" of common speech) which ants are frequently seen carrying when nests are disturbed, were popularly mistaken for grains of wheat.

Is there anything like a systematic direction of these harvesting labors? Do the queen or major-workers, for example, oversee the work of the formicary? The queen has nothing to do (apparently) but replenish the population of the community. Her life is spent, for the most part, under ground. There are no "officers"

that could be distinguished. Each ant acts with an individuality and independence of behavior that quite accurately answers to that oldest description of her habits—(Prov. vi. 7) "Having no guide, overseer, or ruler." Each worker is a law unto herself, and yet the work moves on with perfect harmony, and as if with the utmost unity and system in management. The worker-majors act constantly as sentinels, and once or twice was observed what appeared to be an effort to extend aid to harvesters in gathering seeds; but nothing like leadership.

Mr. McCook then proceeded to describe the interior of a formicary, illustrating his remarks by various specimens preserved in plaster, plaster-casts, models, and drawings. Each formicary has one or more gates, rarely more than two, sometimes three. Sometimes two gates are found connected by a smooth, sunken track. The gates are circular openings at the surface. Within is a vestibule, shelving downwards less than or about 45° ; it is about one to two inches wide, smooth, low, one-half to one-quarter inches in height, shortly diverging in tubular galleries connecting with granaries.

Accumulations of seeds were found within half an inch of the gate, more frequently lower down. Those described in detail were found one and a half inch from the surface. Stripping off the soil in horizontal layers, and working carefully with a trowel, Mr. McCook uncovered a series of oval, circular, and crescent or horse-shoe-shaped rooms, quite uniformly $\frac{1}{4}$ inch in height, but ranging to $\frac{3}{8}$ and $\frac{1}{2}$ inch. Of these, as examples, say, No. 1 was in diameters $3\frac{1}{2}$ by 4 inches; No. 2, $3\frac{3}{4}$ by $3\frac{3}{4}$ inches; No. 3, 6 by 3 inches. The roofs and floors were hard and smooth. In one nest opened in a light yellowish soil, and white "adobe," the black, unctuous "soil" had been brought down ten inches, and the floor, side walls, and roof plastered therewith. The upper granaries were covered with heaps of seeds, which must have nearly touched the roof. Narrow gangways were left at the outer margin between grain heaps and wall. The granaries were connected with each other by tubular galleries. The nurseries or rooms in which the larvæ and pupæ were stored, were of the same character as the granaries. One large nursery, ten inches below the surface, was illustrated by a model and plaster cast. It was exposed entire by careful and extremely tedious manipulation with knife and trowel. The difficulty of this and similar operations was greatly increased by the attacks of the ants, whose sting is quite as severe as the wasp's. Mr. McCook prosecuted these labors with one man and sometimes two constantly engaged in brushing off the enraged insects. The nursery was horse-shoe-shaped, the opening toward the centre of the nest, and one of the prongs directed in the line of the gates, with which it was apparently connected. The floor was hard, smooth, and plastered with the black top soil. The nursery was nine inches across the mouth, the length of the arms five inches,

being also about three inches wide at the mouth, and much narrower, three-quarters of an inch at the junction. Nothing but larvæ, pupæ, and a few callose ants was found in this nursery.

Section cuttings were made, and drawing and casts obtained. It was found that the granaries were arranged one above another from a quarter of an inch to three inches distant. There was a general tendency of the rooms to what may be called floors or stories, which was stronger or more regular in some formicaries than others. A cast and drawing showed how the rooms of each story are connected together, and the stories united with each other and the gates, by galleries. There was a massing of the granaries toward the centre, and an apparent preference for one half of the formicary space to the neglect of the other. Excavations were made several feet in depth, the queens, virgins, and males always eluding search, although the latter were in great number somewhere within the nest. One of the men assisting at the digging, said that in sinking a well he had found these ants coming out of their "holes" fifteen feet below the surface.

Some of the general habits of the ants were described, and their means of attack and defence were referred to, their stinging organs being explained, and the mode of inflicting the wounds, as well as effects, which are very severe, and continue for a day. In the case of children the sting is sometimes quite serious. The universal popular name of these ants in Texas is the "Stinging Ant." The mode of preserving the formicary from inundation by the massing of the workers in the vestibule and around the gates, was observed and described. He was not satisfied that this was the work of design, but it evidently served the purpose of partly stopping the influx of the water, not wholly. Examples were given showing strong intelligence in separating white meal from arsenic, with which it had been mixed, and of the refusal of poisoned molasses. A remarkable garnering by the agriculturals of a swarm of white ants, *Termes flavipes*, beaten down by a shower was described. These insects, males and females, were seized and carried in great numbers within the formicary. Reference was also made to the synonyma of these insects. Two years before Prof. Buckley's description as *Myrmica molefaciens*, Mr. Frederick Smith had described a female from Mexico as *Myrmica barbata*. It is probable that Mr. Smith's name will prove good, but the description, as compared with the insects, was not satisfactory. Moreover, the description of the supposed male in a private letter from Mr. Smith to Mr. Cresson does not at all answer to the Texas species. Not having seen Smith's types, Mr. McCook was still in doubt, and for the present retained the name given by Buckley. It is probable, however, that both the generic and specific names by which the ant has so long been known, must yield, and the name stand (as recently suggested in a private letter by Dr. Forel, the distinguished author of "The Swiss Ants") *Pogono-*

myrmex barbatus, Smith. However, the popular name given by Lincecum, "Agricultural Ants," will be permanent, except perhaps in Texas, where the people will doubtless continue to call the insects the "Stinging Ants."

Remarks on Ants—Prof. LEIDY remarked that he had read Mr. Lincecum's communications on the habits of the agricultural ant of Texas with much interest, and that he was disposed to take a different view of some of his observations from the author. He considered the clearing of a space around the nest, with the exception of a grass that grew thereon, and the collection of the seeds of the grass when ripe, all very probable, but he suspected that the sowing of the seed was accidental rather than intentional. If the grass seeds are favorite food, many may be accidentally dropped and left on the clear space in carrying them from the surrounding region to the nest, and the lost seeds germinating may supply the future harvest field.

He further stated that, during his trips in the summer to the Rocky Mountains, he had observed, through the plains of western Kansas, Colorado, Wyoming, and Utah, formicaries of an ant, which he had suspected to be the same as the agricultural ant. Having submitted specimens of the ant to the Rev. Dr. McCook, he was informed they pertained to a different species, the *Myrmica occidentalis* of Cresson.

The formicaries of this ant include a circular space from three to eighteen feet in diameter with a central cone of less than one-third the diameter at base, and from ten to eighteen inches high.

The circular space is usually devoid of every vestige of vegetation, rarely presenting even the stump of a plant. Occasionally, however, it retains near its boundary some grasses, usually bunches of *Eriocoma* or *Triticum*. The space is mostly level and clear of loose soil, and if stony the pebbles are firmly impacted. The central cone is composed externally of small loose gravel stones, carried by the ants from the interior of the nest. The interior of the cone is composed of finer material, and is excavated into galleries. The finer soil forming the walls of these galleries is mingled with root fibres. These suggest the probability of being retained to give greater coherence to the friable soil. The larger stones on the exterior of the cone were found by weighing to be six times heavier than the workers who carried them to their place. The entrance to the interior of the formicaries consisted usually of one or two openings near the base of the cone.

The outside of the circular formicaries are closely and often densely skirted with vegetation, especially by sage bushes, *Artemisia tridentata*, grease wood, *Sarcobatus vermiculatus*, etc.

Accidentally, Prof. L. continued, he made an observation that rendered it probable the *A. occidentalis*, like many other ants, fostered insects for their saccharine productions. Noticing seven-